Putting the "O" Back in Energy Management

Okay, literally there is no "O" in energy management—agreed. But the title has a second meaning: efficient equipment operations (the "O") is the most under-rated and least understood component of energy management. Today's common wisdom claims energy savings is all about new capital improvements. "Plug it in, walk away, and watch the savings grow". But that kind of thinking is, to use a popular phrase, like so 2008.

Before the economic meltdown—before the credit crunch raised the cost of borrowing an average of 15% —before 45% of American hospitals delayed the purchase of equipment, we could afford to hold that belief. No longer.

The new way to save energy in this shrinking economy won't be from purchasing modern efficient equipment. It will be from reorienting our focus to maximizing the efficiency and savings from our existing equipment through better operations. Instituting operational best practices will reduce the risk of early equipment failure, unscheduled downtime, and mounting utility costs. It will also maximize the return on investment of facilities and equipment. That's how to show your value to senior management when they ask you to find low-cost ways to save money. And frankly, what other choice do you have?

Hospitals enrolled in ASHE's Energy Efficiency Commitment (E^2C) initiative have shown that significant savings are possible with low-cost improvements in operations. Five to ten percent energy savings is typical over a 12-18 month period, but upwards of twenty percent is possible, too. Where does one start? By tuning up existing equipment through retrocommissioning.

Retrocommissioning

Unlike an energy audit, retrocommissioning identifies low-risk changes in O&M practices that improve energy performance rather than identifying expensive new capital upgrades. Retrocommissioning gives you an understanding of how and why building systems are currently operated and maintained, the identification of issues and potential improvements, and the selection of the most cost-effective measures for implementation. Activities include a review of facility documentation, which covers operating requirements; original design documents; equipment lists; drawings of building's main energy-using systems; controls documentation; O&M manuals; and testing, adjusting, and balancing reports.

To help identify potential problem areas, energy systems are monitored using the buildings energy management system (EMS) and portable data loggers. Trend analysis is conducted on annual energy consumption, end-use energy consumption, operating parameters (such as temperatures, flow rates, and pressures), weather data, equipment status and run times, actuator positions, and setpoints.

Finally, functional testing is performed on key systems or pieces of equipment, whereby personnel observe, measure, and record its performance in all operating modes. Such testing helps verify whether a particular improvement is really needed and is cost-effective. For example, the throttling valve on a pump may be found partially open, which indicates that energy savings may be achieved by trimming the impeller to fully open the valve. A functional pump test will determine the value of this potential improvement.

Tune Up Opportunities

All elements of a building and its energy using equipment are assessed as part of the retrocommissioning process, including lighting, supplemental loads, HVAC distribution systems, and heating and cooling plants. The prioritization of various measures are determined after all potential improvements have been identified and the most cost-effective measures have been selected.

LIGHTING. Over time, all lighting systems become gradually less efficient. Certain efficiency losses are unavoidable, such as reductions in light output due to the aging of lighting and equipment. However, other efficiency losses, such as improperly functioning controls, dirt accumulation on fixture lenses, and lumen depreciation can be avoided by regularly scheduled maintenance. A lighting system tune-up should be performed in the following order: 1) Schedule group relamping and fixture cleaning according to maintenance plan, 2) Measure and ensure proper light levels, 3) Calibrate lighting controls.

The savings associated with performing a lighting tune-up will vary depending on the quality and performance of the current lighting system. For example, cleaning alone may boost fixture light output from 10% in enclosed fixtures in clean environments. Simple calibration of occupancy sensors and photocells can restore correct operation, reducing the energy used by the lighting system in those areas by upwards of 50%.

SUPPLEMENTAL LOADS. Supplemental loads are secondary load contributors to energy consumption in buildings. In retrocommissioning, loads can be cut by reducing equipment use and sealing the building envelope. Electrical loads from office equipment can be reduced by encouraging occupants to shut off equipment when it is not in use, using ENERGY STAR® qualified equipment, and enabling power management features. ENERGY STAR qualified equipment often costs the same as comparable nonlabeled equipment, but use about half as much electricity. For the building envelope, air infiltration is often a major energy drain that can be addressed during retrocommissioning. Tightening the building by sealing all air leaks in the windows, doors, walls, and roofs, encouraging the use of revolving doors, and calibrating automatic doors to minimize air loss can reduce heating and cooling loads. Typical savings for large buildings range up to 5% of heating and cooling costs.

DISTRIBUTION SYSTEMS. The systems that distribute air and water for space conditioning throughout a facility may need to be balanced and cleaned as part of a retrocommissioning effort. In a process known as testing, adjusting, and balancing (TAB), HVAC system components are adjusted so that air and water flows match load requirements. The process begins with testing to evaluate the performance of the equipment in its current state. Adjustments to flow rates of air and water are then made for the purpose of balancing the system and matching the loads throughout the building. TAB may be needed for your facility if you receive frequent complaints from occupants about hot or cold spots in a building, renovate spaces for different uses and occupancy, or require frequent adjustments of HVAC components to maintain comfort. The savings associated with TAB come from reductions in the energy used by the heating and cooling system and can range up to 10% of heating and cooling costs.

HEATING AND COOLING SYSTEMS. Both controls and components of the heating and cooling systems present significant savings opportunities. The EMS and controls within a building play a crucial role in providing a comfortable building environment, but over time temperature sensors or thermostats may drift out of tune. Wall thermostats are frequently adjusted by occupants, throwing off controls and causing unintended energy consumption. Poorly calibrated room and duct thermostats, humidistats, and pressure and temperature sensors can increase heating and cooling loads and lead to occupant discomfort. A system tune up will also require inspection of damper and valve controls to ensure they are functioning properly and a review of the building operating schedules to reflect occupancy levels. Savings from these control measures can range up to 30% of annual heating and cooling costs.

Heating and cooling systems can also benefit from the retrocommissioning process. On the heating side, boiler performance can be improved by maintaining boiler steam traps against leaks, adjusting combustion air intake to reduce excessive air supply in fossil-fuel –powered boilers, and improving heat transfer by boiler tube cleaning and water treatment. On the cooling side, operating efficiency can be improved by reducing chiller energy consumption through chilled water reset practices in facilities with central chiller systems, improving heat transfer on both the refrigerant and

Typical Mechanical Equipment and Controls subject to O&M Problems

System or Component	Typical Problems
Energy Management System (EMS)	Downgrade to timeclocks and switches by disabling or overriding, capabilities were never engaged
EMS	Faulty programming or logic, valve and damper hunting
Setpoints	Setpoints incorrect or not optimal for conditions
Schedules	Equipment and lighting operating when not necessary
Air-side economizers	Binding dampers, improper setpoints, sensors out of calibration
Sensors	Out of calibration, broken, or poorly placed
Dampers and Valves	Linkage broken, leaky, malfunctioning (not modulating effectively)
Fans and Pumps	Operating at higher capacities than necessary
Automatic Controls	Not used or poorly programmed
Manual Controls	Poorly operated
Reset Schedules	Not functioning, or set a inefficient levels
Cooling Tower and Chiller	Inefficient staging and sequencing
Boiler Systems	Inefficient staging and sequencing inefficient combustion, failed steam traps
Lighting sweep controls	Not functioning, wrong time, overridden, broken, or poorly zoned
Compressor sequencing	Improper staging and sequencing
Variable air or water flow	VSD parameters restrict full modulation or cause hunting
Equipment cycling (motors)	Excessive or mysterious cycling
Air distribution system	Poor sensor location, dirty filters and coils, blockages

Source: Operation & Maintenance Assessments, PECI, September 1999

water sides of chiller tubes through cleaning and water treatment, and improving part-load performance of systems that use reciprocating compressors. When all retrocommissioning steps are taken together, heating and cooling costs savings can reach upwards of 15%.

Implementing Recommendations

Performing the site assessment and prioritizing recommendations is often the most time consuming and costly part of reviewing current O&M practices. Hospitals may perform the site assessment using in-house engineers or they may hire outside experts. Either way, qualified individuals should have experience in energy management, specific systems, or retro-commissioning. If hiring out, it can be very beneficial for internal staff to assist the outside expert. Such training allows hospital staff to repeat the assessment in the future. ENERGY STAR's Service and Product Provider directory can help you locate companies that provide retrocommissioning services. The Service and Product Provider directory will list only those companies that are the "Most Active" in delivering ENERGY STAR to their clients. Visit www.energystar.gov/spp. For more detailed information on retrocommissioning, type in "retrocommissioning" in the search engine at www.energystar.gov. ASHE

Clark Reed, the Director of the Healthcare Facilities Division for ENERGY STAR at the U.S. Environmental Protection Agency - MC 6202J, 1200 Pennsylvania Ave NW, Washington, D.C. 20460. Email: reed.clark@epa.gov or call 202-343-9146.